



Editorial

Non-invasive cardiac output monitoring – To be or not to be, that is the question!



A B S T R A C T

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Role of hemodynamic monitoring in critically ill patients is still controversial. While invasive monitoring is accurate, it may be counter-productive in view of its essentially invasive nature. Non-invasive monitoring is less intrusive but has not yet been well validated for accuracy compared with gold standard of invasive monitoring.

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Bedside evaluation of hemodynamic status is classically done by measurement of heart rate and mean blood pressure which act as a surrogate marker of tissue perfusion. However, in serious conditions when hemodynamics are borderline, a small shift here or there can turn the clinical course in either direction. Furthermore, in these situations the hemodynamic parameters may change rapidly, so much so that a single measurement may be totally insufficient, mandating a continuous measurement. In 1970, swan ganz¹ introduced the technique of pulmonary artery catheterization in 100 patients of myocardial infarction which led to the beginning of strategy of a routine pulmonary artery catheterization (PAC) for all patients with myocardial infarction for monitoring hemodynamics i.e. pressures, volume status and oxygen saturation. Later on several studies failed to show benefit of routine use of PAC for cardiac output monitoring.² While most of these studies showed no benefit some actually revealed an increased mortality with regular PAC insertion.³ In ESCAPE trial, there was no effect of PAC insertion on study outcomes however; it did provide help in hemodynamic assessment and management.⁴ It was felt that lack of benefit/harm ensued as a result of invasive nature of the measurement and this led to an interest in non-invasive assessment of hemodynamic parameters.

By the turn of this century, various non-invasive or minimally invasive techniques of cardiac output monitoring have been developed. These techniques relying on pressure waveform analysis and bio-impedance are non-invasive, with minimal side effects and practically useful even for bedside monitoring. Several earlier trials

have shown their equivalence with thermodilution technique, which is the gold standard for cardiac output monitoring.

However recent meta-analysis by Peyton and Chong⁵ and Joosten et al.⁶ challenged the validity of non-invasive methods over PAC. They found a huge percentage error with non-invasive technique (of 47%) which is much higher than the acceptable limit of 30% (Table 1). Using techniques which are not even within the acceptable limit of accuracy (when the utility of standard method is itself questionable), puts these non-invasive techniques under a lot of scrutiny.

Thus as of now, though we cannot totally rule out the use of cardiac output monitoring in critically ill patient, when it is obligatory, it is better to use a pulmonary artery catheter rather than relying on these non-invasive techniques.

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Table 1

Agreement between various non-invasive methods and Thermodilution.

| Method | Bias L/min mean | Percentage error mean |
|-------------------------------------|-----------------|-----------------------|
| Esophageal Doppler | −0.77 | 42% |
| Pulse wave transit time | −0.31 | 62% |
| Pulse contour analysis | −0.21 | 45% |
| Partial CO ₂ rebreathing | −0.20 | 40% |
| Thoracic electric bioimpedance | −0.22 | 42% |

From reference 5,6.

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